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Little is known about damage giant wave could cause

By Glennda Chui
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For the past eight years, Jose Borrero has been mapping zones on the California coast that could be flooded in a big tsunami.

``Literally I'm the only one doing it -- one guy with one computer -- and it's a big state with a lot of complex problems,'' said Borrero, a researcher at the University of Southern California who started the work as a graduate student. ``The resources haven't been there to do it how it should be done.''

The lack of funding for this work reflects just how unprepared California is for a giant tidal wave like the ones that killed more than 180,000 around the Indian Ocean in December.

A tsunami alert two weeks ago, triggered by an earthquake off the Northern California coast, awakened many in the state to the potential hazard, which has long been eclipsed by the threat of earthquakes. A state legislator plans to hold hearings Tuesday about problems with the warning, which didn't reach top emergency officials in San Francisco.

There's still a lot scientists don't know about the potential impact of a tsunami on our shores.

They don't know, for instance, what would happen if the most dangerous nearby fault -- the 600-mile Cascadia Subduction Zone, from Vancouver Island to California's Cape Mendocino -- spawned a magnitude 9 earthquake, triggering tsunamis like those that struck Asia in December. The last giant quake on the Cascadia was in 1700; the next could be years away or just around the corner.

They don't know what a tsunami would do as it rushed through the Golden Gate into San Francisco Bay, menacing low-lying communities, ports and oil terminals. ``That's a very good question, and we don't have an answer for it,'' said Richard Eisner, manager of the state's tsunami program.

In the Bay Area there has been little tsunami damage, aside from a 5-foot wave generated by the 1964 Good Friday earthquake in Alaska. It damaged boats and docks to the tune of $1 million.

Even our most famous quake, in 1906, set off only a teeny tsunami -- 4 inches high, as measured at Fort Point on the south side of the Golden Gate. The 1989 Loma Prieta quake also set off a tsunami in Monterey Bay, only 8 inches high.

Mapping tsunami zones

The only place in the continental United States where people are known to have died in tsunamis is Crescent City, a Northern California fishing port and tourist destination with a population of 7,500.

``The perception in California is that tsunamis are extreme events, and that there is very little we can do to mitigate the hazards,'' said Costas Synolakis, director of the Tsunami Research Center at the University of Southern California. ``In reality, until recently we have not been able to model tsunamis adequately. It was a hazard that was ignored.''

Synolakis and Borrero first proposed mapping California's tsunami zones in 1995. It's a complex undertaking that goes far beyond drawing a line on a map. In any given place, the height of the wave depends on the contours of the ocean bottom. The area it floods depends not only on the shape of the coastline, but on roads and other features that would channel the water.

So after modeling the tsunami with computers, Borrero walks the shoreline, drawing on years of experience in investigating tsunamis to create a more realistic map.

Until recently, Synolakis said, the greatest danger was thought to be from tsunamis sweeping across the ocean from distant places. A 1998 earthquake in Papua New Guinea changed that.

A magnitude 7.1 quake, it was not considered big enough to set off a dangerous tsunami. But the shaking triggered an undersea landslide that abruptly changed the shape of the ocean bottom, raising a tsunami that sent 50-foot waves washing over the island at more than 30 mph. Two thousand people died.

Parts of the California coast are poised for such underwater landslides, including Monterey and Santa Monica bays and the Santa Barbara Channel.

Government money for tsunami mapping and public education has been scant -- about $275,000 a year for each of the five Pacific states. While a bill before Congress would provide $35 million a year for tsunami preparedness, most of that would be spent on ocean buoys to detect tsunamis.

The rest would be divided among 22 coastal states rather than just those along the Pacific, and some emergency planners fear California could be left with less funding than it has now.

Local burden

The state maps are just one step in getting ready for tsunamis. With them, coastal communities can plan evacuation routes and put up signs telling people to move to higher ground if they feel a strong earthquake or see the water recede from shore.

For the most part, cities and counties have to pay for these things themselves.

``No money, practically speaking, is going to local planning, training, response

and warning systems,'' said Michael Dever, emergency services administrator for Santa Cruz County.

Preparing for tsunamis, he said, is ``the most daunting, complicated challenge we've got in emergency management in California. How can I get that many people to go in the right direction to the right place, all at the same time, and what am I going to do with them when they get there? And think of the rebuilding: If the whole Beach Boardwalk area were wiped out, that's a fundamental, iconic part of Santa Cruz.''

He said the county's fine-scale mapping of its hazard zones shows that a major tsunami would flood more than 5,000 buildings, nearly 400 roads and four fire stations.

Monterey County also has drawn up detailed tsunami hazard maps for six coastal cities.

But ``we have nothing specific as far as evacuation areas at this time,'' said Kyle Oden, Monterey County's emergency services planner. ``To be perfectly honest, none of this has been tested.''

Some jurisdictions are using homeland security money to install warning systems. San Francisco upgraded its civil defense sirens; San Mateo County plans to buy an automatic phone-dialing system to warn residents in emergencies.

In many places, the plan is to send police cars or fire engines to the shore to blare warnings from loudspeakers.

San Mateo County officials are kicking around the idea of asking the Coast Guard to fly a helicopter along the beaches, broadcasting a warning, said Bill O'Callahan, supervisor for the county office of emergency services.

Ultimately, Synolakis said, California needs hazard maps that reflect the probability of flooding from tsunamis set off by specific earthquakes, not just a general worst-case scenario.

What he discovered with the June 14 alert, he said, ``is that if you don't have information, your emergency management looks at this and says, `I'm not going to evacuate tens of thousands of people, and then no wave shows up.' ''

An interactive tsunami inundation map for San Mateo and San Francisco counties is available online at www.abag.ca.gov/bayarea/eqmaps/tsunami/tsunami.html. The Santa Cruz County map is at http://sccounty01.co.santa-cruz.ca.us/oes/newtsunami.html.